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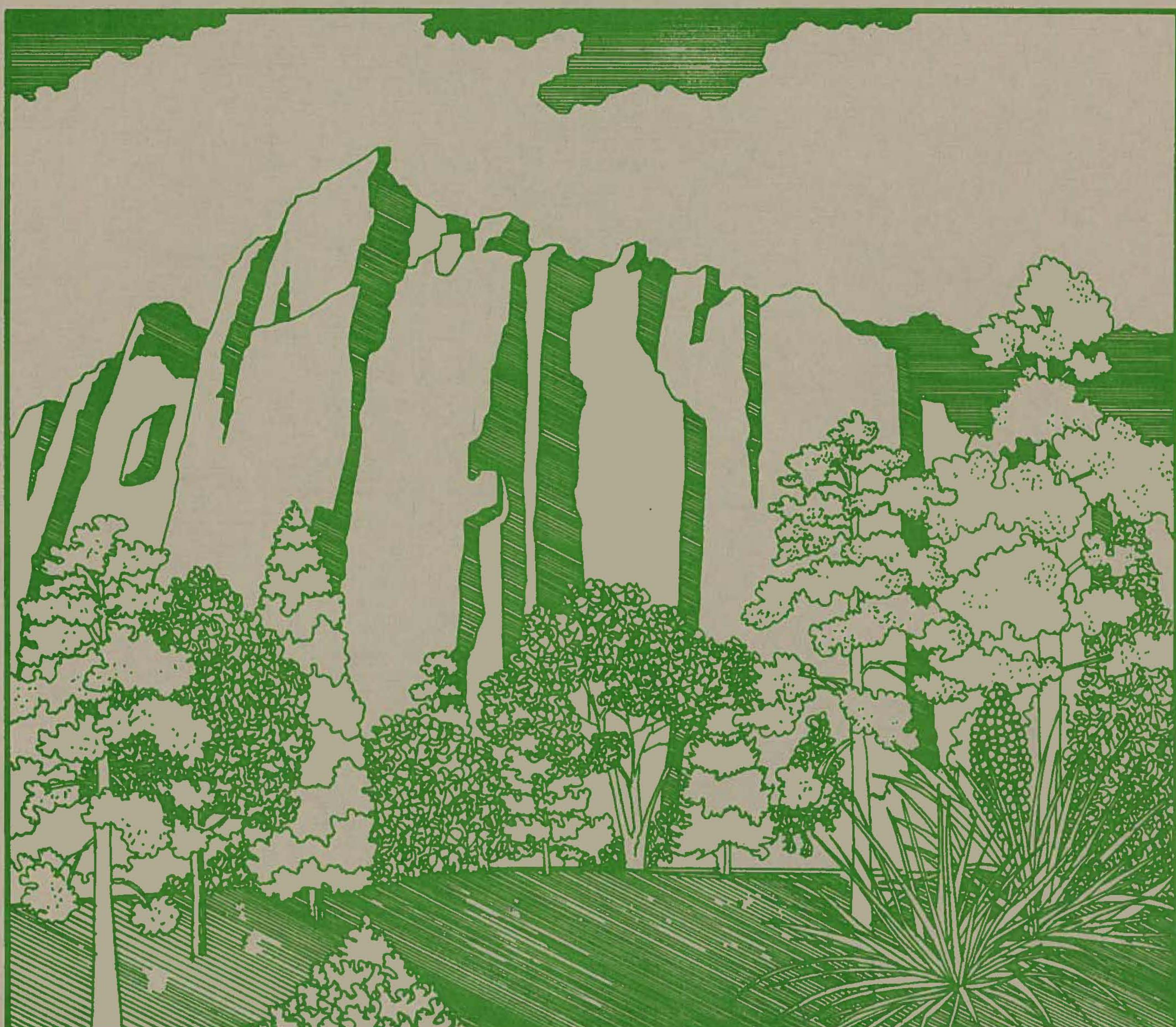
Forest Pest Management Report

R-3 87-3

BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
New Mexico
December 1986



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USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

PREPARED BY:

T. J. Rogers

T. J. ROGERS, Entomologist

RECOMMENDED BY:

James P. Linnane

JAMES P. LINNANE, Assistant Director

APPROVED BY:

Douglas L. Parker

DOUGLAS L. PARKER, Director

INTRODUCTION

During late August and early September 1986, a western spruce budworm (WSB), Choristoneura occidentalis Free., biological evaluation was conducted on the Carson National Forest (CNF). This biological evaluation consisted of an aerial survey (refer to our letter of August 27, 1986) and a WSB egg mass survey. The purpose of this biological evaluation is to provide:

1. Information on the extent and severity of WSB defoliation occurring on the CNF and adjoining lands in 1986.

2. Estimates of budworm defoliation trends expected to occur in 1987 based on recent WSB egg mass surveys.

Specific districts evaluated in detail in 1987 included the Questa, Taos, and Penasco Ranger Districts (RD). Management alternatives and recommendations are also presented.

SUMMARY OF THE CURRENT OUTBREAK

WSB defoliation in northern New Mexico was visibly[1] detected on the Questa and Taos Entomological Units beginning in 1976. New infestations of budworm were next detected on the Tres Piedras and El Rito[2] Entomological Units in 1982. In 1985, budworm defoliation was detected for the first time in recent history on the Penasco Entomological Unit. Based on 1986 aerial insect and disease surveys approximately 203,036 acres of susceptible host type were defoliated on the CNF, and adjacent private and Indian Pueblo lands. Total acreage defoliated in 1986 are summarized by individual ownership below and by entomological units for the period 1976 through 1986 in Table 1.

TECHNICAL INFORMATION

Insect. Western spruce budworm, Choristoneura occidentalis Free.

Hosts. Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco.
White fir, Abies concolor (Gord. & Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry.

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[1] Visible defoliation based on aerial insect and disease detection surveys.
[2] Formerly included as part of the Tres Piedras entomological unit from 1980 through 1981.

Life History. The WSB completes one generation each year (Furniss and Carolin 1977)

Stage	Time	Location on host
Egg	August	On needles
Small larvae	Overwinter	In hibernaculum (silken cocoons) on branches and trunk.
Larger larvae	June	On buds, strobile, and foliage.
Pupae	July	On foliage.
Adults	August	In flight.

Evidence of Infestation

1. Presence of partially eaten foliage.
2. Immature and/or mature larvae feeding on current year's needles.
3. Current year's shoots webbed together.
4. Trees dying from the top downward after several years of heavy defoliation.

Extent of Current Outbreak--WSB defoliation decreased slightly on the CNF, Taos Pueblo and adjacent private ownerships from 277,655 acres in 1985 to 203,036 acres in 1986. Budworm defoliation was also detected for the first time during the current outbreak on Picuris Pueblo lands. Defoliation observed was categorized as follows: Light, 114,920 acres; moderate, 83,920 acres, and heavy, 4,196 acres. Acres defoliated by ownership class are summarized below and in Table 1.

	Defoliation			
	Light	Moderate	Heavy	Total
Carson NF	94,080	83,920	4,196	182,196
Taos Pueblo IR	1,040	-	-	1,040
Picuris Pueblo IR	400	-	-	400
Adjoining Private	19,400	-	-	19,400

Predicted defoliation trends are based on 1986 egg mass densities according to McKnight et al. 1970:

Egg Mass density [a]	Predicted defoliation class [b]
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for increasing infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

[a] Number of egg masses per square meter of foliage.
[b] Defoliation class limits (percent of new growth).
Undetectable <5 percent
Light >5 to 35 percent
Moderate >35 to 65 percent damage
Heavy >65 percent

RESULTS AND PREDICTION OF TREND

Questa Entomological Unit--This entomological unit consists of the Questa RD and adjoining private ownerships. Defoliation caused by the WSB on this entomological unit decreased substantially from 71,298 acres in 1985 to 17,840 acres in 1986. This is a four-fold decrease from 1985 levels. The majority of the defoliation on this unit was categorized as light to moderate and occurred along Hondo and Cabresto Canyons and the Pinabete Peak Area. A few pockets of heavy defoliation were also detected northeast of Kiowa Village and northwest of Pinebeta Peak (Figure 1).

Based on WSB egg mass survey results, WSB populations are at a low level at the present time. Egg mass densities per meter square (M^2) of foliage on this unit decreased from an average of 6.9 in 1985 to 0.5 in 1986. These current egg mass densities are more than 13 times lower than those occurring in 1985. Specific areas sampled in 1986 on this entomological unit are summarized below.

Areas Sampled	N	Egg Mass Densities/ M^2 of Foliage ± S.E.
Cabresto Canyon	5	1.6 ± 0.7
Bobcat Pass	5	1.4 ± 0.9
Lower Red River [1]	10	0
Middle Red River [2]	5	0
Upper Red River [3]	5	0

[1] Fawn Lakes to Red River Ski Area
[2] Red River Ski South to 4th of July Canyon
[3] 4th of July Canyon South to East Fork of Red River

These data indicate that WSB populations on the Questa Entomological Unit have collapsed to low levels and that defoliation in 1987 will be undetectable.

Taos Entomological Unit--This unit includes the Taos Ranger District, Taos Indian Pueblo lands, and adjoining private ownerships. WSB-caused defoliation also decreased substantially throughout most of the host type on this entomological unit in 1986. Defoliation on this unit decreased from 89,884 in 1985 to 20,440 acres in 1986. This is about 5 times lower than in 1985. Most of the defoliation (Figure 2) was light and occurred along State Highway 64 near Palo Flechado Pass, Forest Service Road 437 between Buena Suerte and Lagunita Canyons (Rio Chichuita Drainage), and along portions of the Rio Grande Del Rancho Drainage. Some light defoliation was also detected east of Osha Mountain.

WSB egg mass densities on this entomological unit averaged 3.6 per M^2 of foliage. This is a significant decrease from 1985 levels which averaged 11.4 egg masses per M^2 of foliage. Egg mass densities for specific areas sampled on this entomological unit are summarized below:

Areas Sampled	N	Egg Mass Densities/ M^2 of Foliage ± S.E.
Capulin Canyon	5	6.4 ± 2.2
Valle Escondido	5	2.2 ± 0.7
Palo Flechado	5	1.4 ± 0.6
Osha Mountain	5	2.0 ± 1.4
Rio Grande Del Rancho	5	6.2 ± 2.8

On the basis of these egg mass data, WSB-caused defoliation is expected to be largely undetectable throughout most of the host type on this unit again in 1987.

Penasco Entomological Unit--This entomological unit includes the Penasco RD, Picuris Pueblo Indian Reservation, and adjoining private ownerships. WSB defoliation on this entomological unit increased slightly from 29,759 acres in 1985 to 31,800 acres in 1986. Defoliation to current years foliage on this unit was categorized as light to moderate and occurred mainly within the La Serna, Santa Barbara and Las Trampas Grant areas, and portions of the Pecos Wilderness (Figure 3).

Egg mass densities per M^2 of foliage on this entomological unit ranged from 3.2 to 16.3 and averaged 8.1 overall. In 1985, budworm egg mass densities averaged 9.0 per M^2 of foliage sampled. Average egg mass densities from specific areas sampled on the Penasco Unit are summarized below:

Areas Sampled	N	Egg Mass Densities/ M^2 of Foliage ± S.E.
Lower Rio Pueblo[1]	12	13.2 ± 2.7
Upper Rio Pueblo[2]	15	4.7 ± 1.2
La Junta	15	3.2 ± 0.6
Rio Santa Barbara	7	16.3 ± 3.1
Picuris Peak	3	9.5 ± 2.4

[1] Sipapu Ski Area to Tres Ritos
[2] Tres Ritos to Vega Del Estillero

On the basis of these egg mass survey results, WSB-related defoliation is expected to continue throughout much of the mixed conifer host type on the Penasco Entomological Unit again in 1987. Intensity of defoliation is expected to be moderate (>35 to 65 percent defoliation to new foliage growth) along the lower Rio Pueblo and Rio Santa Barbara drainages and Picuris Peak, and light (>5 to 35 percent defoliation to new foliage growth) in La Junta Canyon and the Upper Rio Pueblo Drainage in 1987. Top-killing and tree mortality in these areas are not expected to occur for several more years. Impacts to visual

quality (top-killing and tree mortality) in these areas are also expected to be relatively minor.

Tres Piedras Entomological Unit--This unit includes the Tres Piedras RD, the northeast corner of the El Rito RD from State Highway 110 East to Posos Lake (Kiowa Mountain and immediate area), and adjoining private ownerships. Although portions of WSB infestations on this unit have been suppressed on three separate occasions (1982, 1983, and 1984), treatment efforts achieved only limited success. WSB defoliation was detected in all areas previously treated with insecticide. Defoliation increased from 44,852 acres in 1985 to 73,976 acres in 1986 and was categorized as mostly light to moderate; however, a few pockets of heavy defoliation were detected in a few areas (Figure 4). Although egg mass surveys were not conducted on this unit in 1986, defoliation is expected to continue throughout most of the type again in 1987.

El Rito Entomological Unit--This unit includes the El Rito RD and adjoining private lands, excluding Kiowa Mountain. Defoliation on this entomological unit increased from 18,290 acres in 1985 to 41,000 acres in 1986 and was categorized as light to moderate (Figure 5). Although no egg mass surveys were conducted on this unit in 1986, defoliation is expected to continue in 1987.

Canjilon Entomological Unit--This entomological unit consists of the Canjilon RD and adjoining private ownerships. WSB defoliation on the Canjilon Entomological Unit was relatively minor and unchanged from 1985 levels. Defoliation detected on this unit totaled 4,960 acres in 1986 compared to 4,857 acres in 1985. Defoliation (Figure 6) was light and primarily occurred near Middle Canjilon Lakes and west of the Vega Paz Tank Ponds. Defoliation is expected to continue on this unit again in 1987.

Valle Vidal Entomological Unit--This unit includes the Valle Vidal Unit which is administered by the Questa RD. WSB defoliation on this entomological unit remained relatively unchanged from 1985 levels. Defoliation on this unit totaled 18,480 acres in 1986 compared to 18,715 acres in 1985. Defoliation was categorized as light to moderate (Figure 7) and occurred along the western boundary and central portions of the unit. Although egg mass surveys were not conducted on this unit in 1986, defoliation is expected to continue for several more years.

MANAGEMENT ALTERNATIVES

Alternatives for managing the current WSB outbreak consist of two courses of action: (1) No action or (2) direct suppression with insecticides. Silvicultural management is not considered an effective strategy for preventing damages or suppressing WSB populations during the current outbreak. However, silvicultural management to reduce stand susceptibility/vulnerability to future WSB outbreaks should be a principal consideration in all vegetation management activities on the Forest.

No Action--With this approach, the outbreak is allowed to run its course until a population collapse occurs from one or a combination of: (a) A lack of foliage to maintain larval populations; (b) unfavorable weather conditions; (c) heavy predation or parasitism; or (d) a microbial epizootic. The principal adverse impacts relate to stand growth and yield (understory and overstory growth loss, top-kill, and mortality) seed and cone losses, and perceived

losses in scenic or visual quality. Where these adverse effects are not perceived to conflict with management objectives, the no action alternative is an appropriate decision.

Direct Suppression--Suppression tactics using insecticides can be considered for the current outbreak to reduce tree damages in the short-term, thus protecting resource values. Alternative approaches are as follows:

1. Developed Recreation Sites--Individual trees in campgrounds, picnic areas, and other high-use sites can be sprayed with ground-based equipment or treated with systemic insecticides to prevent defoliation and protect visual quality and "recreation experience" objectives. These treatments are generally successful in preventing significant amounts of defoliation during the year of treatment, however, moth and larval dispersal from nearby untreated trees may reinfest treated trees necessitating annual retreatment in subsequent years.

2. High Valued Forest Areas--Aerial insecticide applications can, in some instances, be used to prevent unacceptable damages to high valued areas. To maximize effectiveness, treatments should be considered early in the outbreak cycle and before budworm populations reach high densities (>15 larvae per 100 buds). This treatment strategy is short-term and may require several treatments during the outbreak cycle. Alternative development using this strategy must consider current and predicted budworm population trends, projected stand damages, and a benefit/cost or comparable economic analysis.

The probability of success (meeting management objectives) for a suppression strategy is a principal factor in developing alternatives or deciding on a course of action. The following concerns must be considered.

1. Choice of insecticide--All registered insecticides should be considered. Insecticides currently registered for use against the WSB in a forest environment include:

A. Carbaryl (carbamate insecticide)--The Sevin-4-oil formulation of carbaryl has given consistently satisfactory results in suppressing budworm outbreaks throughout the West. An outbreak on the Santa Fe National Forest, New Mexico, was successfully suppressed in 1977, and the outbreak remained at a low level for over 5 years (Telfer, Ragenovich, and Rogers 1982). In 1984 a WSB suppression project was conducted on 240,900 acres of the Lincoln National Forest and Mescalero Apache Indian Reservation, New Mexico with a combination of carbaryl and B.t. In 1986, 2 years after treatment, WSB populations on the Lincoln National Forest and Mescalero Apache Indian Reservation are still at very low, undetectable levels (Bennett and Linnane, 1985). Carbaryl is a nonpersistent pesticide which is available for general use. One pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

B. Acephate (organophosphate insecticide)--Orthene is a nonpersistent insecticide registered for use against the WSB and other forest defoliators. Although this insecticide has been shown to be effective against the budworm, it has never been used in the Southwest against the WSB.

C. Malathion (organophosphate insecticide)--is a nonpersistent, broad spectrum insecticide registered for use against more than 100 insects including

the WSB. However, it is not recommended because it has yielded inconsistent results in suppressing budworm outbreaks.

D. Mexacarbate (carbamate insecticide)--Mexacarbate (Zectran) is a nonpersistent pesticide which is available for use against the WSB. Mexacarbate is applied at a rate of 0.15 pounds of active ingredient per acre. No lasting environmental effects have been identified when properly applied at this rate. In the Southwest, mexacarbate requires additional pilot testing before it can be recommended for operational use.

E. Microbial Insecticides--*Bacillus thuringiensis* (*B.t.*), a bacterium, has been used experimentally and operationally in the Southwest. Results with *B.t.* in the Region have been inconsistent. Foliage protection has generally been poor during the year of application. However, foliage protection the year following treatment has been documented. More testing and evaluation of *B. t.* is needed.

2. Budworm resurgence or reinvasion--Treated areas are subject to insect population resurgence and reinvasion. Resurgence of an insect population within a treated area is largely dependent on efficacy of insecticide treatment. On the Santa Fe National Forest in 1977 (Telfer, Ragenovich, and Rogers 1982) and Lincoln National Forest and Mescalero Apache Indian Reservation in 1984 (Bennett and Linnane 1985) where insecticide treatments successfully reduced pest populations to very low levels, resurgence was minor and insignificant for several years following treatment. The effects of insect reinvasion on the other hand can be mitigated by either (a) treating the entire entomological unit where resource values are threatened or (b) if only a portion of the entomological unit must be treated, buffering treated from untreated portions of the unit.

3. Delivering insecticide to target foliage in steep terrain--Usually areas being contemplated for treatment to maintain visual quality objectives are in steep, rugged terrain, complicating aerial applications. Often, aircraft and spray systems which deliver insecticide adequately in moderate terrain cannot consistently fly low enough (approximately 50 feet above the canopy) nor deliver enough insecticide at optimum droplet size to target foliage in steep terrain.

4. The need for retreatment--Suppression strategies are short-term actions. In dealing with budworm outbreaks which may have a longevity from 5 to 15 years, the need for retreatment is likely. The costs of these treatments need to be considered in appropriate economic analyses.

RECOMMENDATIONS

1. Long-term Management Forest-wide

The WSB should be considered a long-term forest management problem and addressed through long-range planning using the Integrated Forest Protection approach. The objective is to reduce stand susceptibility/vulnerability. Specific silvicultural prescriptions should include but are not limited to: (1) Intermediate cuttings, such as commercial or precommercial thinning and sanitation/salvage cutting, to increase stand vigor, regulate stocking, and favor nonhost tree species; (2) regeneration cuttings using clearcut and

shelterwood methods designed to create a mosaic of even stands with a lower percentage of true fir, and (3) artificial regeneration with nonhost tree species such as ponderosa pine and aspen where appropriate.

2. Short-term Management of the Current Outbreak

Questa and Taos Entomological Units

Based on the results of this WSB biological evaluation, budworm population densities on the Questa and Taos Entomological Units have collapsed to very low levels. Defoliation in 1987 is expected to be minor and mostly undetectable on these units. We, therefore, recommend that no action be taken to suppress the WSB on these units in 1987.

Penasco Entomological Unit

WSB populations on this unit have recently increased. The principal forest management objective threatened by the current WSB infestation on this unit is visual quality within the Rio Pueblo and La Junta Drainages. Although defoliation damages are minor at the present time and the infestation is expected to worsen, no action is recommended. Since the majority of the high value areas identified and evaluated are located along the lower portions of these drainages near environmentally sensitive areas (streams or human habitations) only B.t. can be considered. Direct suppression with B.t. in these areas, however, is not recommended since the results from past projects using this insecticide have been inconsistent and marginal at best in the Southwest. Thus, the probability of successfully reducing insect populations to low levels and preventing defoliation with this insecticide is estimated to be about 1 in 5.

Direct suppression with ground applications of insecticides is recommended for all high-risk developed recreation areas (campgrounds and picnic areas) and visitor information centers where individual high value trees must be protected from defoliation to maintain visual quality and esthetics. Specific areas to be treated in 1987 should be evaluated on an individual basis before being treated to ensure WSB larval populations are sufficiently high to warrant treatment.

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TABLE 1. Summary of the egg mass and aerial detection surveys on the Questa, Taos, Tres Piedras, El Rito, and Penasco Entomological Units.

Questa Entomological Unit		1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
New egg mass/square M foliage			9.9	17.9	43.1	47.6	31.3	26.3	16.7	38.5	6.9	0.5
Egg mass density ratio[a]			3.4:1	1.7:1	2.4:1	1.1:1	0.7:1	0.8:1	0.6:1	2.3:1	0.2:1	0.1:1
Actual defoliation[b] (acres)	L	1,900	13,080	2,560	3,174	22,850	4,800	2,025	7,625	625	5,613	14,040
	M	300	960	2,330	5,197	15,550	39,700	8,550	1,975	17,750	23,733	1,640
	H	0	320	384	6,221	3,275	18,550	36,400	175	34,325	28,134	2,160
TOTAL		2,200	14,360	5,274	14,592	4[illegible],675	63,050	46,975	9,825	52,700	71,298	17,840
Taos Entomological Unit												
New egg masses/ square M foliage		38.3	22.3	36.3	42.8	50.6	14.1	17.2	26.3	25.0	11.7	3.6
Egg mass density ratio		1.7:1	0.6:1	1.6:1	1.2:1	1.2:1	0.3:1	1.2:1	1.5:1	0.9:1	0.5:1	0.3:1
Actual defoliation (acres)	L	9,400	15,040	2,725	6,477	31,200	6,375	7,125	18,500	15,625	52,452	20,440
	M	6,600	10,800	2,790	9,191	26,750	41,125	18,550	6,825	26,550	30,346	-
	H	560	0	4,250	282	6,975	15,775	3,375	50	31,750	7,086	-
TOTAL		16,560	25,840	9,765	15,950	64,925	63,275	29,100	25,375	73,925	89,884	20,440

TABLE 1. Summary of the egg mass and aerial detection surveys on the Questa, Tres Piedras, El Rito, and Penasco Entomological Units--Continued

Tres Piedras Entomological Unit[c]		1980[d]	1981[e]	1982	1983	1984	1985	1986
New egg masses/square M foliage		1.8	35.0	6.8	22.3	14.7	13.2	
Egg mass density ratio			19.4:1	0.2:1	3.3:1	0.6:1	0.9:1	
Actual defoliation (acres)	L	550	5,650	2,625	8,800	14,525	25,797	22,000
	M	0	50	1,725	9,650	25,725	18,903	49,720
	H	0	0	0	50	525	152	1,756
TOTAL		500	5,700	4,350	18,500	40,775	44,852	73,476

El Rito Entomological Unit[f]

New egg masses/square foliage		29.7	33.5	18.6	42.6	20.8		
Egg mass density			1.1:1	0.5:1	2.3:1	0.5:1		
Actual defoliation (acres)	L	325	1,700	20,275	7,225	3,925	15,012	24,600
	M	900	1,100	13,075	35,350	26,400	2,775	16,120
	H	75	200	600	1,275	23,750	503	280
TOTAL		1,300	33,950	33,950	43,850	54,075	18,290	41,000

TABLE 1. Summary of the egg mass and aerial detection surveys on the Questa, Taos, Tres Piedras, El Rito, and Penasco Entomological Units--Continued

Penasco Entomological Unit		1985	1986
New egg masses/square M foliage		9.0	8.1
Egg mass density ratio			0.9:1
Actual defoliation	L	19,972	26,080
(acres)	M	8,892	5,720
	H	895	-
TOTAL		29,759	31,800

[a]Egg mass density ratio is the ratio of new egg masses in the survey year to new egg masses of the previous year.
[b]Actual defoliation as determined from aerial detection survey; L = light, M = moderate, H = heavy.
[c]Egg mass surveys not conducted in 1986.
[d]Data obtained from report R-3 81-4.
[e]Data previously combined under Tres Piedras Entomological Unit 1981.
[f]Egg mass survey not conducted on this unit in 1985 and 1986.

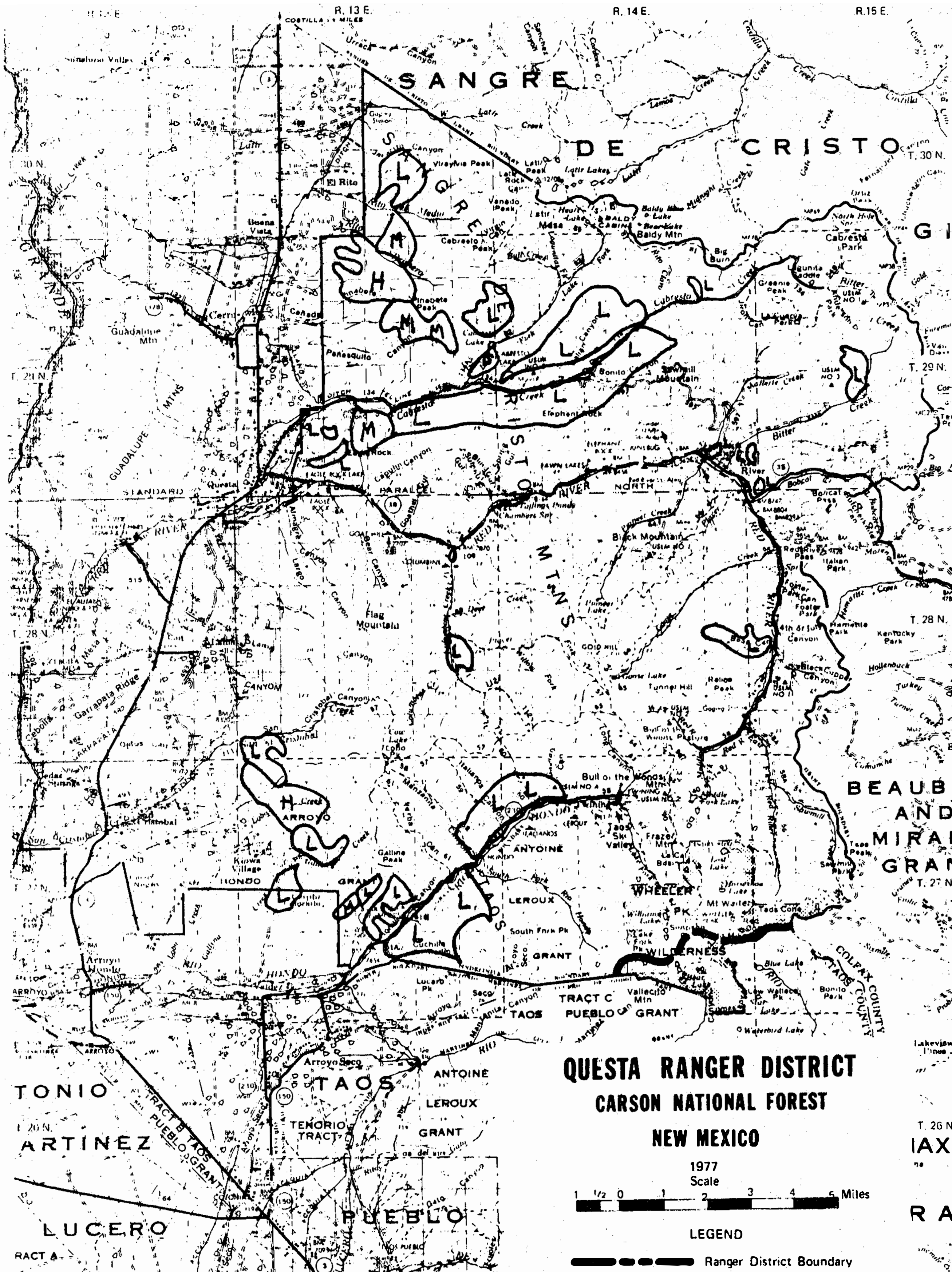

FIGURE 1. Extent of Western Spruce Budworm Defoliation, Questa Entomological Unit, 1986

L = Light; M = Moderate; H = Heavy

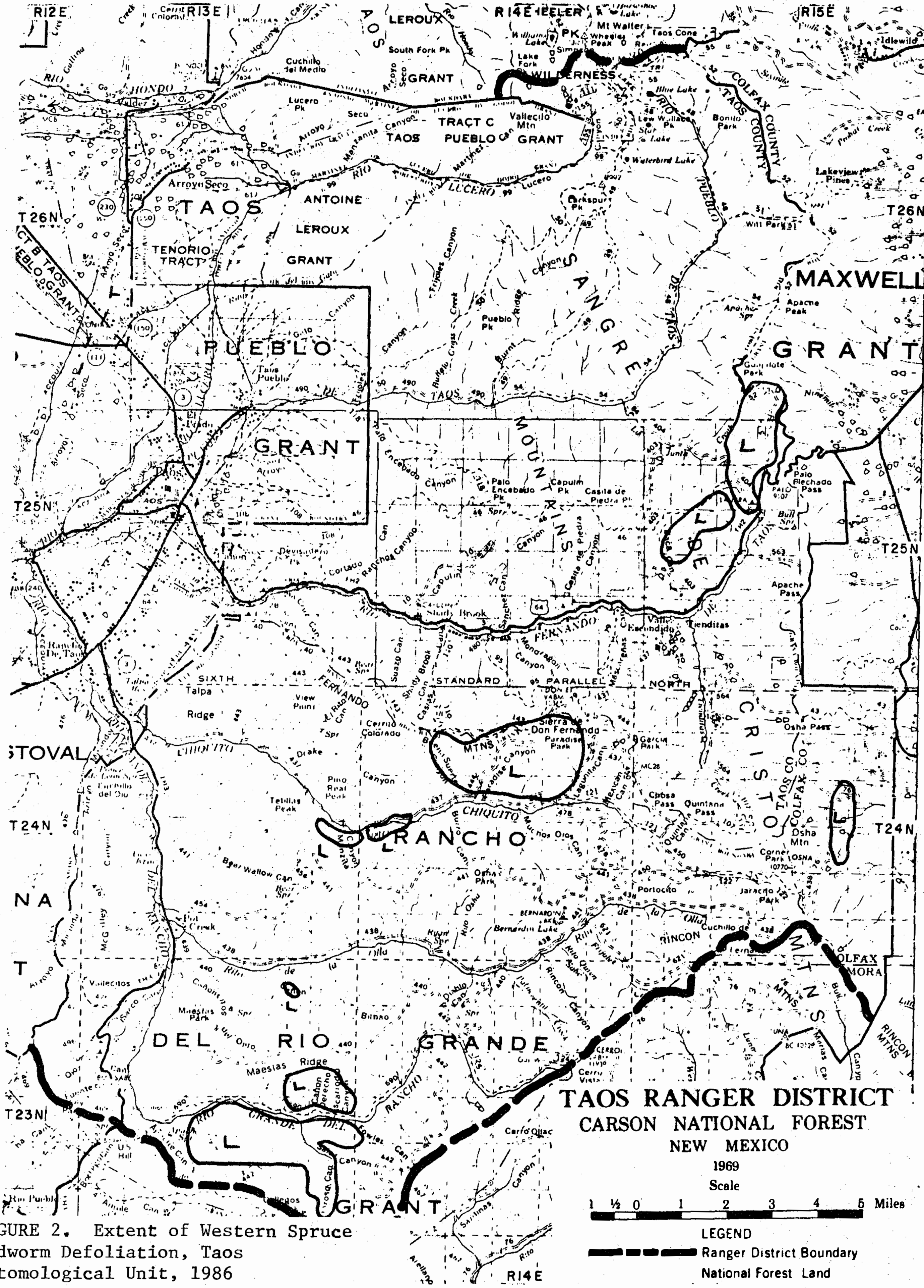

FIGURE 2. Extent of Western Spruce Budworm Defoliation, Taos Entomological Unit, 1986

L = Light   M = Moderate   H = Heavy

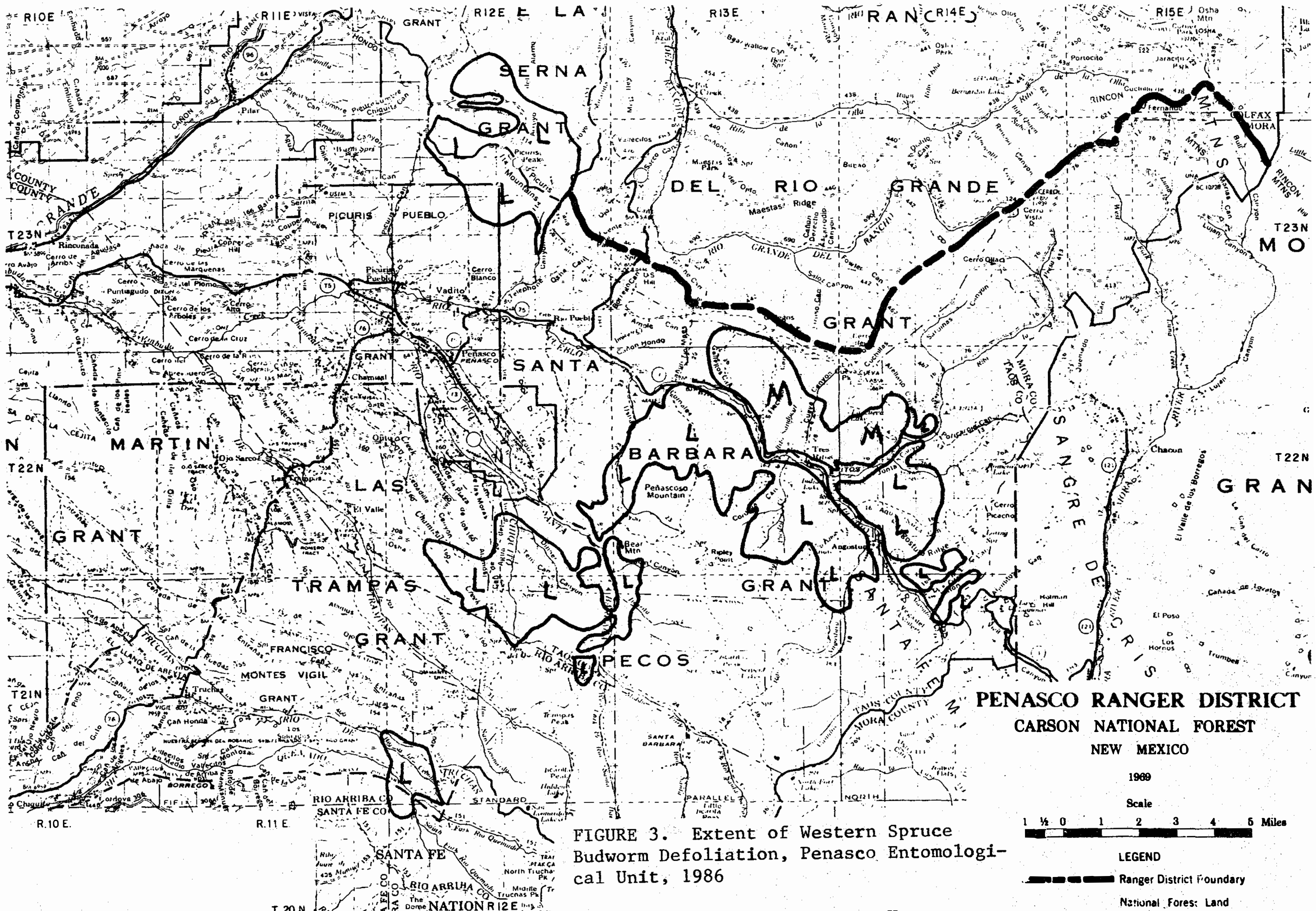

FIGURE 3. Extent of Western Spruce Budworm Defoliation, Penasco Entomological Unit, 1986

L = Light M = Moderate; H = Heavy

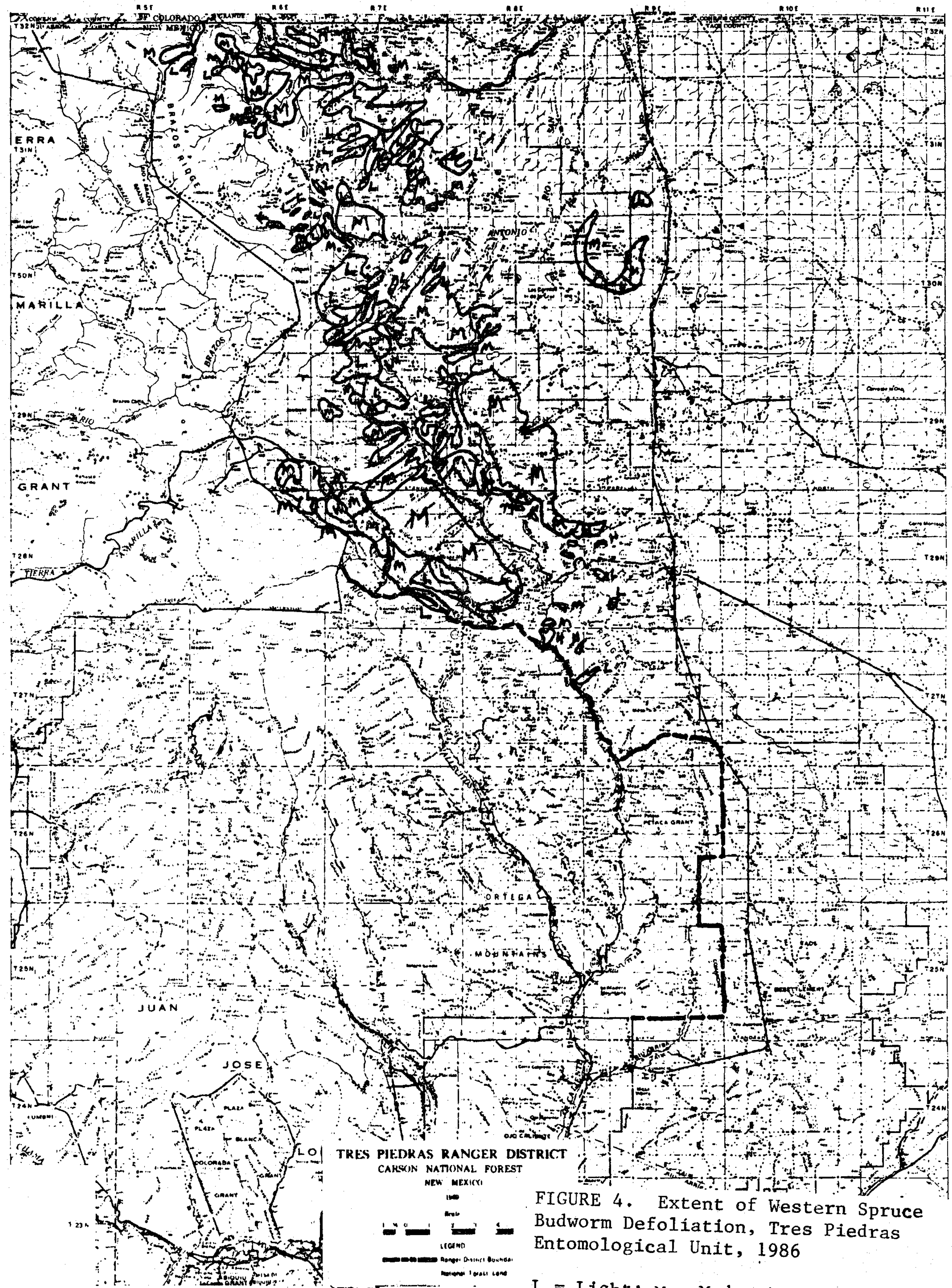

FIGURE 4. Extent of Western Spruce Budworm Defoliation, Tres Piedras Entomological Unit, 1986

L = Light; M = Moderate; H = Heavy

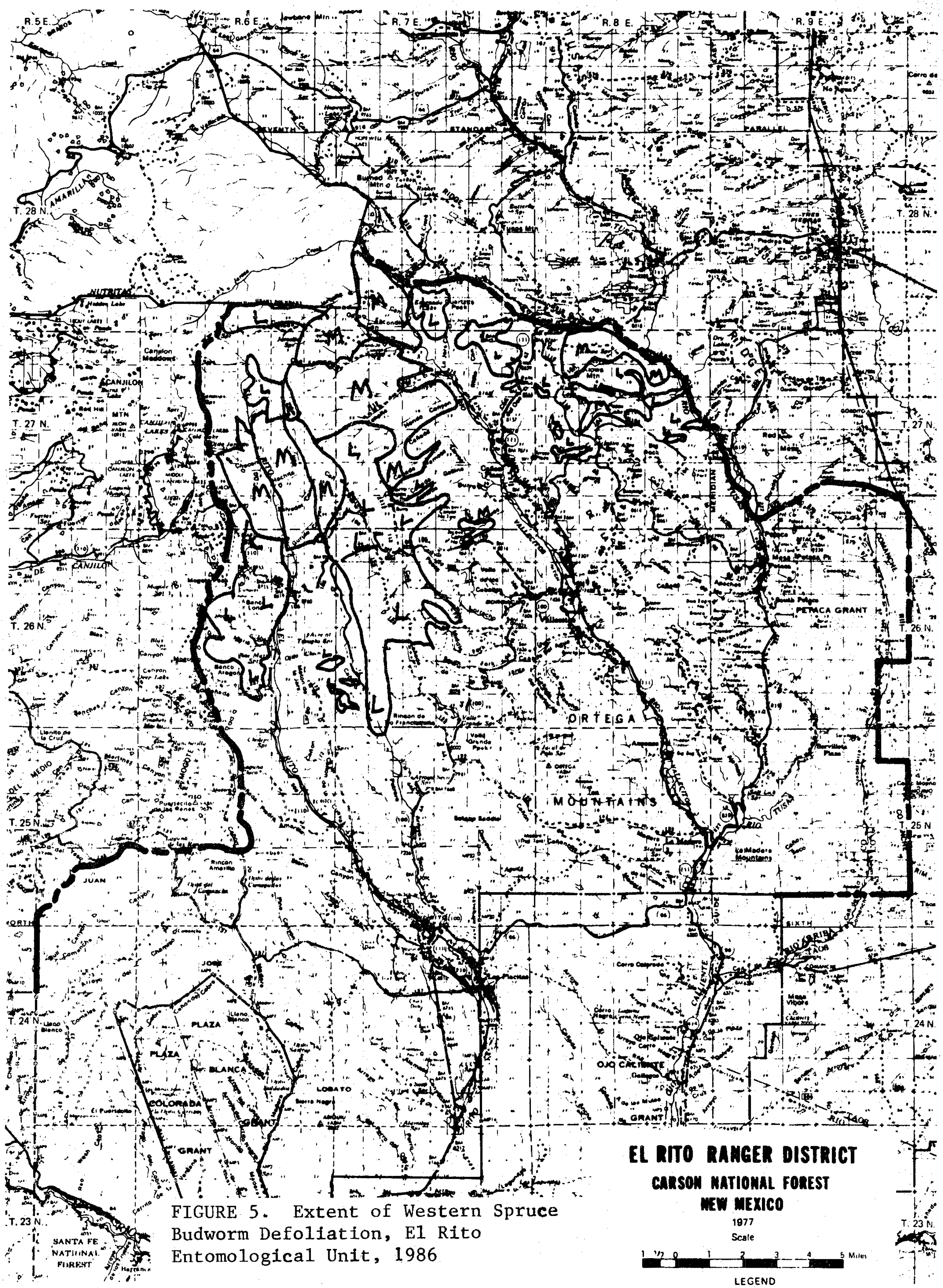

FIGURE 5. Extent of Western Spruce Budworm Defoliation, El Rito Entomological Unit, 1986

L = Light; M = Moderate; H = Heavy

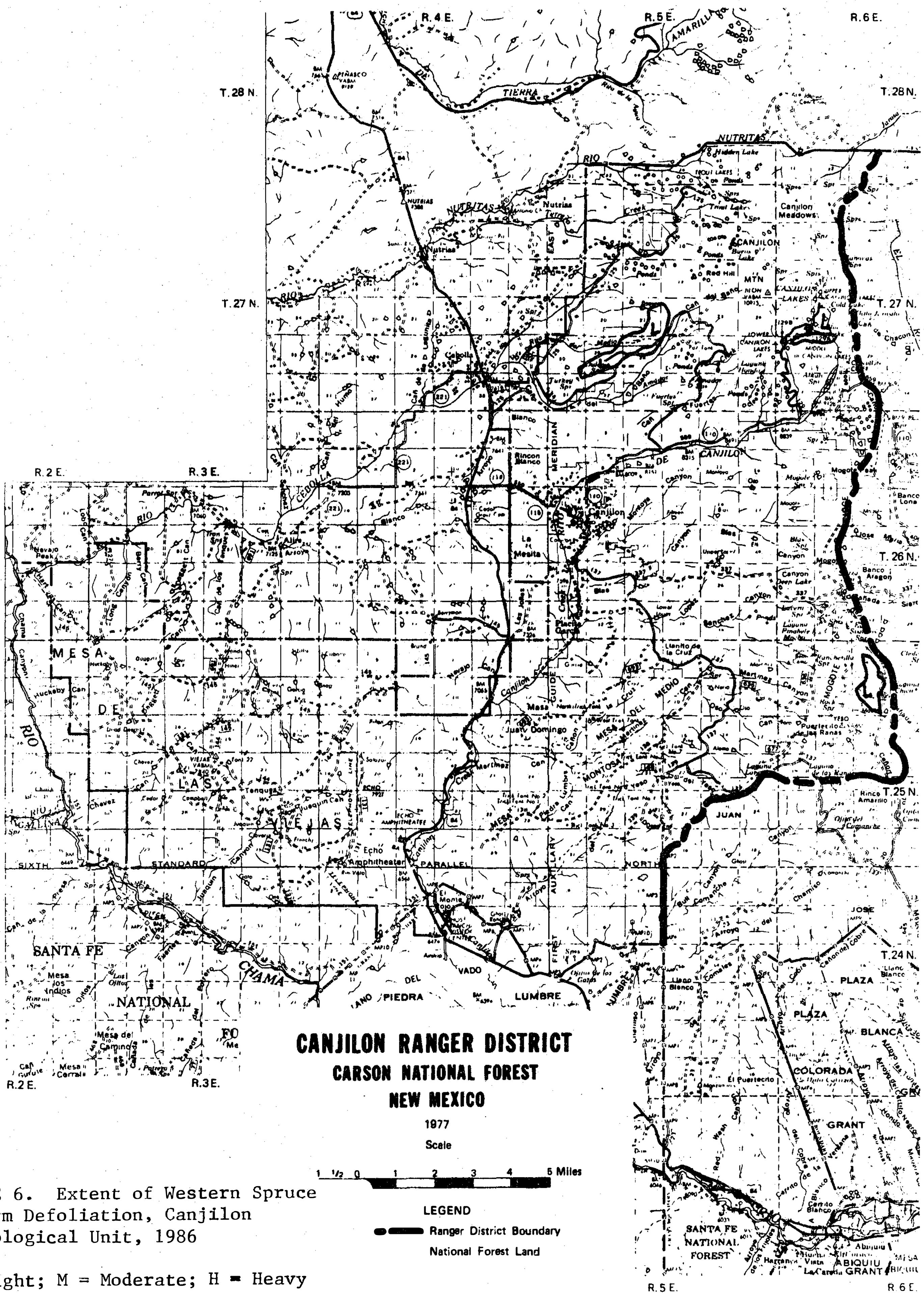

FIGURE 6. Extent of Western Spruce Budworm Defoliation, Canjilon Entomological Unit, 1986

L = Light; M = Moderate; H = Heavy

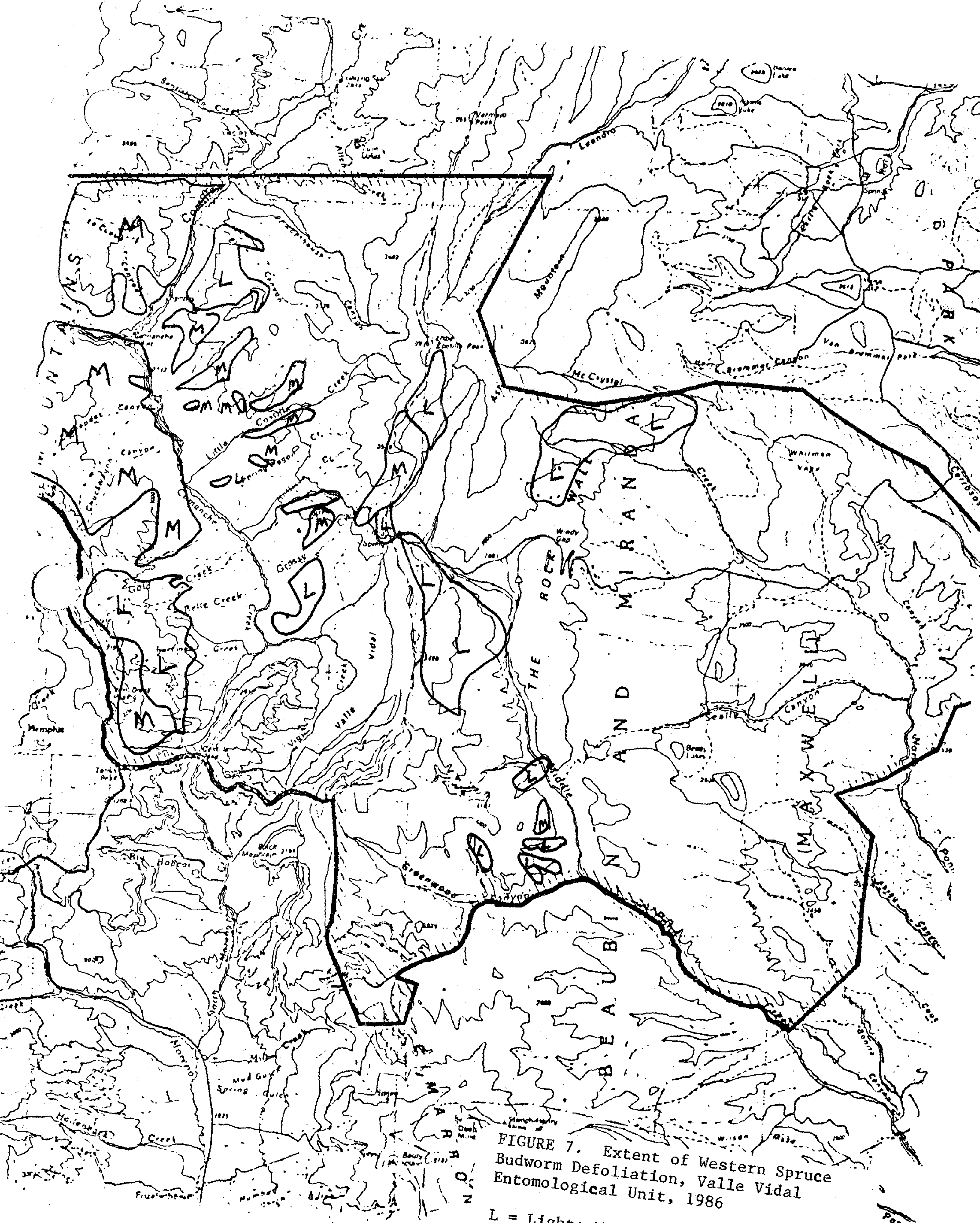

FIGURE 7. Extent of Western Spruce Budworm Defoliation, Valle Vidal Entomological Unit, 1986

L = Light; M = Moderate; H = Heavy